The Imperative for High-Performance Audio Computing

LAC2009

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Introduction

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The Technology – History

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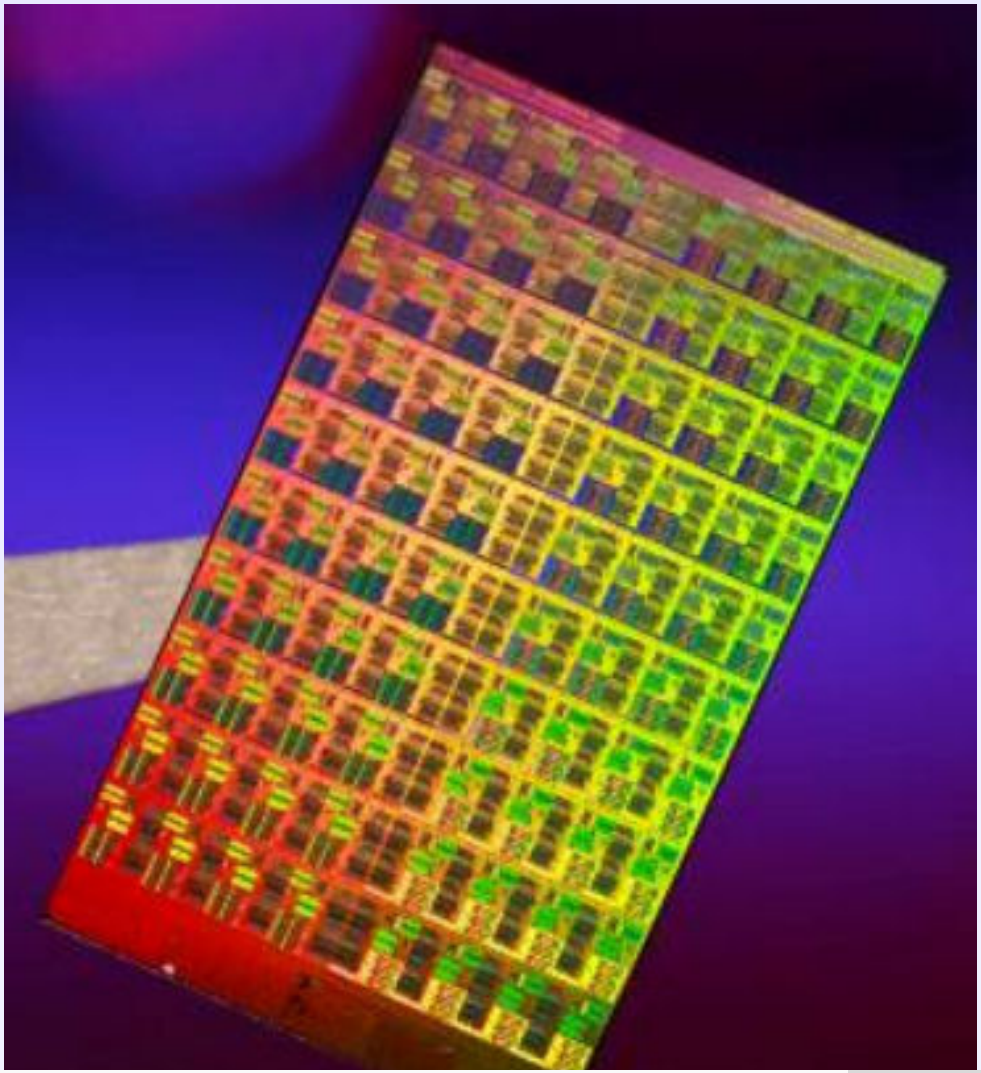
Intel Polaris 80-core



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ClearSpeed

CLEARSPEED ADVANCE™ X620

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- Midas in York: dataflow through SGI net

In Computer Science:

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- Timewarp
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They have a version of C extended with **poly** and **mono** variables. (Similar to MasPar system)

and there are others.

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Amdahl's Law

The relationship between sequential and parallel computation is summarised in Amdahl's law, which is stated as:

$$1/(S + P/N)$$

where S is the fraction of serial computation, $P = 1 - S$ is the amount of parallelisable computation and N is number of processors.

HiPAC Processors

The primary defining characteristics of a HiPAC dsp process:

- use of highly parallel fine-grained architectures (*e.g.* following the SIMD model), though we do not exclude more "conventional" multi-core computation
- real-time performance or better
- implies low latency
- ideal and "no-compromise" forms of algorithms
- new processes, and hence new effects and sounds, not simply "more of the same" - whether more reverbs or more voices.

A HiPAC case study - the Parallel Execution of Csound

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But now I present here a new (and different) application:

MultiCore Csound

The challenge is to make sensible use of a multicore processor, to provide more processing in real-time

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Is it Worthwhile?

We are creating a database of instruction counts for each opcode, parameterised by initialisation, instructions/sample and instructions/control.

There is no point in parallel execution if the overhead of threads is comparable with the cost.

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Opcode	init	Audio	Control
table.a	93	23.063	43.998
table.k	93	0	45
butterlp	9	29.005	5.478
butterhi	19	30.000	35
butterbp	20	30	71
oscil.ka	69	17	46
bilbar	371.5	1856.028	86
ags	497	917.921	79475.155

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- Clashing use of global variable
- Adding into the output bus
- Other global structures

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Use of spin locks for output bus and others

Each k-cycle looks at a DAG of dependency, and schedules opcodes to maintain semantics.

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Consider the fragment of Csound:

```
instr 1
  a1 oscil p4, p5, 1
     out   a1
endin
instr 2
  gk oscil p4, p5, 1
endin
instr 3
 a1  oscil gk, p5, 1
      out  a1
endin
```

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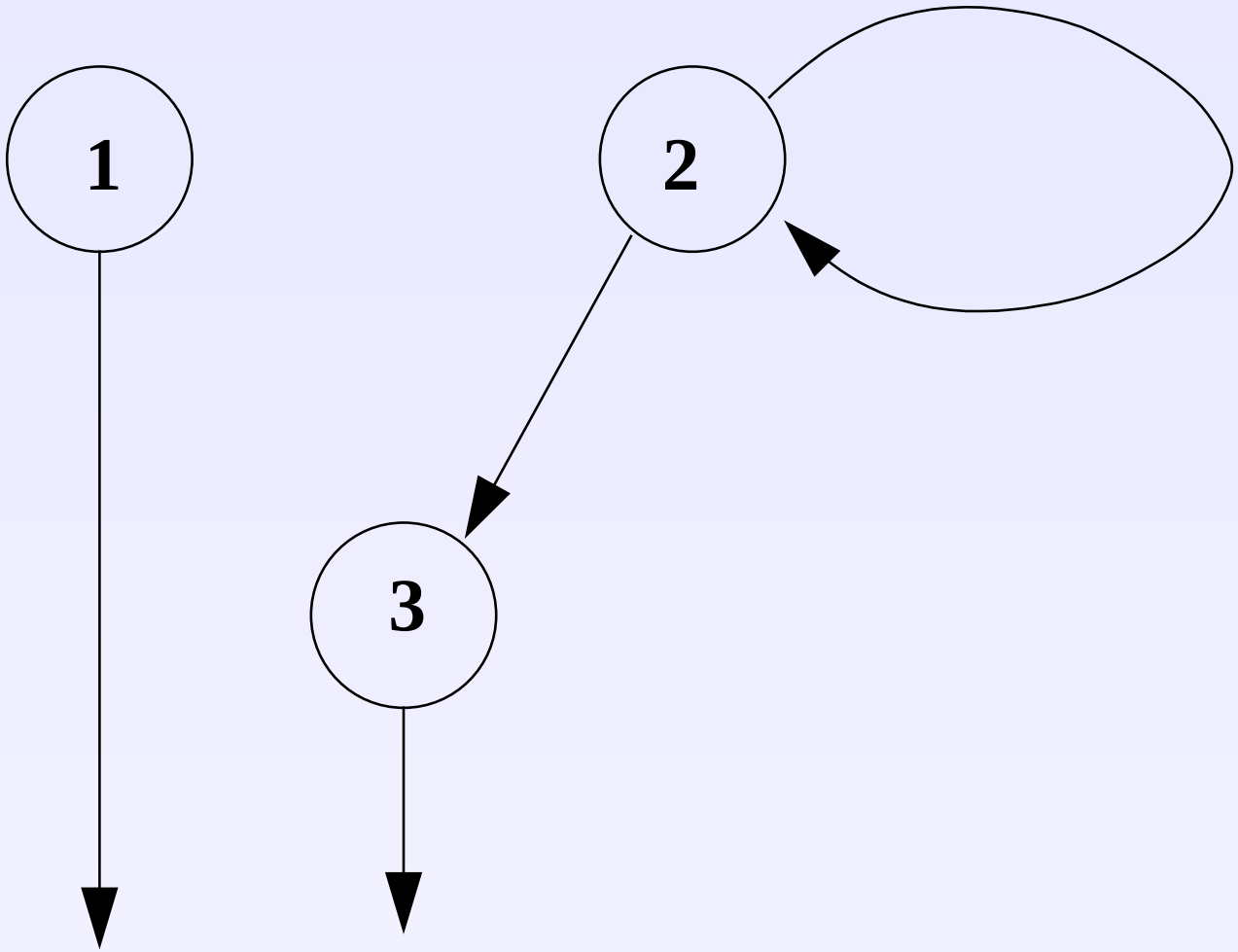

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Current state is that it runs, not totally integrated. The cost database not used yet.

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Some performance figures running on a dual-core machine:

Best so far is **Electric Priest** that goes from 53s to 34s

Xanadu is less good at only 10% gain.

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This hardware will soon be cheap enough. The “techies” must grasp it.

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